

CLAIMS

1. An air-cycle air conditioning system for a body defining an interior space, the air conditioning system comprising:

a compressor receiving air from the interior space and pressurizing the air;

an intercooler receiving pressurized air from the compressor and removing heat from the air;

an expander receiving cooler pressurized air from the intercooler and removing work from the air by reducing the pressure of the air; and

a plenum defining a mixing chamber receiving cold air from the expander, the plenum defining an inlet port and an outlet port in communication with the mixing chamber, the inlet port receiving air from the interior space for mixing with the cold air from the expander, the outlet port providing mixed air to the interior space through the outlet port.

2. The air conditioning system of claim 1, further comprising a fan in communication with the mixing chamber for flowing the air through the plenum.

3. The air conditioning system of claim 2, wherein the fan is positioned proximate the inlet port of the plenum and draws air into the mixing chamber from the interior space.

4. The air conditioning system of claim 1, wherein the plenum defines an intake chamber separated from the mixing chamber, the intake chamber in communication with an inlet of the compressor.

5. The air conditioning system of claim 4, wherein the intake chamber includes a baffle to reduce the noise generated by the compressor's intake of air.

6. The air conditioning system of claim 1, wherein the plenum collects moisture condensing from the mixing of interior air and cold air in the mixing chamber.

7. The air conditioning system of claim 6, wherein the plenum is structured to provide the collected moisture to the compressor.

8. The air conditioning system of claim 7, wherein the moisture is provided to an inlet of the compressor.

9. The air conditioning system of claim 6, wherein the plenum is positioned vertically above the compressor.

10. The air conditioning system of claim 1, wherein the plenum is positioned proximate the compressor.

11. The air condition system of claim 1, wherein the system forms a cartridge defined by a housing enclosing the compressor, intercooler and expander.

12. The air conditioning system of claim 11, wherein the body is a standalone refrigeration cabinet receiving the cartridge.

13. The air conditioning system of claim 12, further comprising an electric motor driving one of the compressor and expander, and wherein the housing encloses the electric motor.

14. The air conditioning system of 11, wherein the plenum is defined by an upper wall, a lower wall and side walls of the housing, and further defined by an internal wall extending between the upper, lower and side walls of the housing.

15. The air conditioning system of claim 14, wherein the internal wall separates the compressor and expander from the intercooler.

16. The air conditioning system of claim 11, further comprising an electric motor directly driving one of the compressor and expander, an output shaft of the motor being integrally tied to an input shaft of one of the expander or compressor.

17. The air conditioning system of claim 16, further comprising a belt and pulley linking the input shafts of the expander and compressor, and further comprising a shroud covering the belt and pulley.

18. The air conditioning system of claim 17, wherein the shroud includes at least two telescoping shields making the shroud expandable.

19. The air conditioning system of claim 1, wherein the expander and compressor have an efficiency of at least 85%.

20. The air conditioning system of claim 19, wherein the expander and compressor are screw-type expanders and compressors.

21. The air conditioning system of claim 19, further comprising an electric motor driving the compressor and expander, wherein the electric motor has an efficiency of at least 90%.

22. The air conditioning system of claim 21, wherein the intercooler has an effectiveness of at least 90%.

23. An air-cycle air conditioning system for a body defining an interior space, the air conditioning system comprising:

a compressor receiving air from the interior space and pressurizing the air, the compressor having an actuatable exhaust port;

an intercooler receiving pressurized air from the compressor and removing heat from the air;

an expander receiving cooled pressurized air from the intercooler and removing work from the air by reducing the pressure of the air;

a temperature sensor positioned upstream from the compressor to sense the temperature of the air going into the compressor from the interior space of the body; and

a controller operatively connected to the compressor to control the speed of the compressor based on an algorithm utilizing the temperature of the air going into the compressor and the pressure of the air exiting the compressor.

24. The air conditioning system of claim 23, wherein the controller actuates the exhaust valve to regulate the pressure of the air exiting the compressor to control air temperature in the interior space.

25. The air conditioning system of claim 23, wherein the temperature of the air going into the compressor is indicative of the temperature of the air in the interior space.

26. The air conditioning system of claim 23, further comprising an electric motor driving the compressor or expander, and wherein the system forms a cartridge defined by a housing enclosing the compressor, intercooler, expander and electric motor.

27. The air conditioning system of claim 23, further comprising an electric motor driving the compressor or expander, and wherein the speed of the motor and compressor determine the mass flow of air exiting the expander and mixing with the air from the interior space.

28. The air conditioning system of claim 23, further comprising a plenum defining a mixing chamber receiving cold air from the expander, the plenum defining an inlet port and an outlet port in communication with the mixing chamber, the inlet port receiving air from the interior space for mixing with the cold air from the expander, the outlet port providing mixed air to the interior space.

29. The air conditioning system of claim 28, further comprising a fan in communication with the mixing chamber for flowing the air through the plenum.

30. The air conditioning system of claim 28, wherein the plenum is an enclosure defined by a pair of side walls and pair of end walls connected by a bottom wall.